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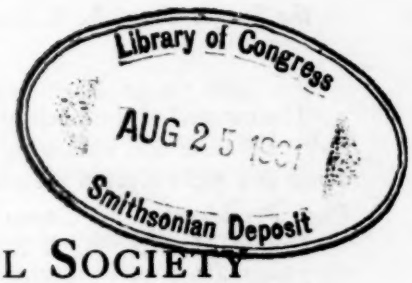
BULLETIN

OF THE



AMERICAN PHYSICAL SOCIETY

PROGRAM OF THE

SCHENECTADY MEETING

AT

UNION COLLEGE AND THE GENERAL ELECTRIC COMPANY

SEPTEMBER 10–12, 1931

PUBLISHED BY THE AMERICAN PHYSICAL SOCIETY
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The American Physical Society

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AMERICAN PHYSICAL SOCIETY

SCHENECTADY MEETING, SEPTEMBER 10–12, 1931

The 172nd meeting of the American Physical Society will be held in Schenectady, N. Y., on Thursday, Friday and Saturday, September 10, 11 and 12.

The first session will begin at 10 o'clock Thursday morning, September 10 in Rice Hall at the General Electric Company, commemorating the one hundredth anniversary of the experiments of Faraday and Henry on electromagnetic induction.

Thursday evening at 7:00 o'clock the regular *dinner of the American Physical Society* will be held at the Mohawk Golf Club.

Friday morning at 9:00 o'clock the society will convene in two parallel sections in the Physics Building at Union College. These sessions will be devoted to the reading of the contributed papers. Titles and abstracts of these papers are given in the following pages. These abstracts have not been corrected by the authors. After correction they will be published in an early number of the Physical Review. Authors should send corrections to the Editor of the Physical Review at the University of Minnesota, Minneapolis, Minnesota.

Saturday morning at 9:00 o'clock the society will again convene in Rice Hall at the General Electric Company for a Symposium on Magnetism.

Registration Bureau. Registration will begin at 8:30 Thursday morning at the Research Laboratory, General Electric Company. The Council of the Society has authorized a registration fee of $1.00 for each physicist attending the meeting.

Members are requested to register as soon as possible on Thursday morning at the General Electric Research Laboratory.

A registration and information bureau will be maintained throughout the course of the meetings. During the two days in which the meetings are held at the General Electric Laboratory the registration desk will be at the laboratory. For the day of the meeting at Union College the registration desk will be in the corridor of the Physics Building, Union College.

Members and their wives are invited to make free use of the facilities thus provided for any necessary information or aid. Inquiries may be made either in person or by telephone. Telegrams and mail may be sent c/o The Registration Bureau, General Electric Research Laboratory, Schenectady, N. Y.

Headquarters. The headquarters for the Society will be the Van Curler Hotel.

Hotel Accommodations

The Van Curler—Headquarters—Rooms 210.
Single room with bath $3.50–$6.00.
Double room with bath $5.00–$10.00 per room.
Single room without bath (with toilet and lavatory) $2.50–$3.00.
Double room without bath (with toilet and lavatory) $4.00–$5.00.

The Mohawk—Rooms 176.
Single room with bath $3.00–$4.00.
Double room with bath $5.00–$7.00.
Single room without bath $2.00–$2.50.
Double room without bath $3.50–$5.00.

The Vendome—Rooms 80.
Single room $1.50–$2.50.
Double room $3.00–$3.50.

The Hough—Rooms 75.
Single room $1.50–$1.75.
Double room $2.50–$3.50.

The Edison—Rooms 60.
Single room $1.50–$2.50.
Double room $2.50–$3.50.

The Foster—Rooms 60.
Single room $1.50–$3.50.
Double room $3.00–$6.00.

Schenectady Y. M. C. A.—Rooms $1.00–$2.00.

Of these only the first two named hotels have dining rooms. All the hotels on the list are within walking distance of both the General Electric Company and Union College.

Those who desire hotel accommodations should write directly to the hotel.

Travel. Schnectady, on the main line of the New York Central, is very accessible by railroad.

Surrounded as it is by the Catskills, the Berkshires, the Green Mountains and the Adirondacks, Schenectady also offers unusually beautiful approaches by motor from almost any direction. Garages for over-night storage of cars are plentiful in Schenectady. The General Electric maintains a parking field at the works for parking of cars during the daytime.

PROGRAM OF PAPERS

Faraday-Henry Centennial Meeting. Thursday morning will be devoted to a meeting to commemorate the one hundredth anniversay of the notable experiments of Michael Faraday and Joseph Henry in the field of electromagnetic induction. At this meeting two invited papers will be read. A paper on the work of Faraday written by Sir William Bragg will be read by Professor John Zeleny of Yale University, and a paper on the work of Joseph Henry will be presented by Professor W. F. Magie of Princeton University.

Contributed Papers. On Friday morning the regular contributed papers will be read in two parallel sessions beginning at 9:00 A.M. These sessions will be held in Lecture Rooms A and B, Physics Building, Union College.

Symposium on Magnetism. On Saturday morning at 9:00 A.M. there will be held a Symposium on Magnetism in which the following invited papers will be given:

Some New Experimental Methods in Ferro-magnetism
Professor S. L. Quimby, Columbia University

The Interpretation of Ferro-magnetic Phenomena
Dr. F. Bitter, Westinghouse Electric and Mfg. Company

Round Table Discussions. After the sessions on Friday and Saturday mornings an opportunity will be given for round table discussions on the following subjects:

Quantum mechanics	Magnetism
Atomic spectra	Acoustics
Molecular spectra	Physical Optics
X-rays and crystal structure	The teaching of physics
Electric discharge through gases	Engineering physics

These discussions will begin at 11:30 A.M. on Friday and 11:00 A.M. on Saturday. No group discussion on magnetism will be held on Friday.

INSPECTION TRIPS THROUGH THE RESEARCH LABORATORY OF THE GENERAL ELECTRIC COMPANY

Thursday afternoon, 2:30–5:00 P.M. will be devoted to an inspection trip through the General Electric Research Laboratory. Guides will be provided to take visitors through the Laboratory and show them as many phases of the work in progress as is practicable in the time available.

In case any visitor has a particular interest which he would like to talk over with a member of the laboratory an appointment during the course of the meetings may easily be made by inquiry at the registration desk.

On Friday morning those ladies who so wish will be given an opportunity to see some interesting phases of the work of the Company, such as the Refrigerator Department, the Research Laboratory, etc. It is suggested that those ladies who wish to go on such a trip should make known their intention at the registration desk sometime during Thursday.

ENTERTAINMENT

Thursday Luncheons. On Thursday the members of the Society will be guests of the General Electric Company for luncheon at the works Restaurant. At the same time the ladies present at the meetings are invited to attend a luncheon at the Riverwood Inn, an inn beautifully situated on the Mohawk River about five miles from Schenectady. Transportation will be provided for the visiting ladies. The daily bulletin board will give the exact time and the place from which cars will leave Schenectady. A tea is being arranged for the ladies on Thursday afternoon.

Physical Society Dinner. The regular dinner of the American Physical Society will be held at the Mohawk Golf Club at 7:00 o'clock Thursday evening for members and their wives. Price per plate $1.75. As at all functions throughout the meetings, informal dress will be in order.

Luncheon at Union College. On Friday both members and their wives will be guests of Union College at luncheon. This will be at 1:00 o'clock and, weather permitting, will be held out of doors in the rose garden on the Union College grounds.

Trip to Lake George. A trip to Lake George for Friday afternoon has been arranged. Busses will be waiting at the Union College grounds at 2:45 P.M. to take the crowd to the D and H station where a special train will run to the lake. A specially chartered steamer will make a three hour tour of the lake and dinner will be served on board. The return to Schenectady will be by train arriving about 10:30 P.M. Price for the entire trip including dinner, $4.25.

Lake George aside from the natural beauty of its heavily wooded shores is a spot of great historical interest with its old forts dating back to the French and Indian wars.

This seems an excellent opportunity for members of the society to visit one of the most interesting regions in this country. The holding of the trip depends upon a minimum number guarantee. *If you have not already signified your intention of going, please return your card immediately.*

Sports. Those wishing to play golf may obtain guest cards for either the Mohawk Golf Club or the Edison Club which will enable them to play upon payment of the usual greens fee. Tennis courts are available both at Union College and at the General Electric Works. Those desiring to play either golf or tennis should seek further information at the registration desk.

Other meetings for the current season are as follows:

173. November 27–28, 1931. Chicago.
174. December 18–19, 1931. Pacific Coast. Berkeley.
175. Annual Meeting. New Orleans. December 29–30, 1931.
176. February meeting. Cambridge, Mass. Time to be announced later.

CALENDAR

Thursday morning, September 10:	8:30	Registration through-out the morning.
G. E. Research Laboratory	10:00	Faraday-Henry Centennial. A paper on Faraday written by Sir William Bragg and read by Professor John Zeleny. A paper on Henry by Professor W. F. Magie.
Thursday afternoon	1:00	Luncheon at Works Restaurant for members of Society as guests of the G. E. Company.
	2:30–5:00	Inspection trip through Laboratory for members of the Society.
	1:00	Ladies Program. Luncheon at Riverwood Inn as guests of the G. E. Company.
Thursday evening	7:00	Physical Society dinner at Mohawk Golf Club.
Friday morning, September 11	9:00	Contributed papers;
Union College Physics Building		Lecture Room A: Papers 1–11. Lecture Room B: Papers 12–21. See pages 10–12 for titles and abstracts.
	11:30	Informal group discussions on subjects indicated by return cards.
	11:30	Ladies Program. Trip through departments of the G. E. Company.
Friday Afternoon	1:00	Luncheon at the College for members and their wives as guests of Union College.
	2:45	Trip to Lake George.
Saturday Morning, September 12	9:00	Symposium on Magnetism.
G. E. Research Laboratory, Rice Hall		A paper on New Experimental Methods in Ferro-Magnetism by Professor S. L. Quimby and a paper on Interpretation of Ferro-Magnetic Phenomena by Dr. F. Bitter.
	11:00	Informal group discussions as on Friday.
Saturday Afternoon		Sports. For details see section above.

W. L. SEVERINGHAUS, *Secretary*,
Columbia University, New York City

August 26, 1931.

FRIDAY MORNING AT 9 O'CLOCK

Union College—Physics Building

Lecture Room A

1. The vectorial photoelectric effect in thin films of alkali metals. HERBERT E. IVES, *Bell Telephone Laboratories.*—It is assumed that the photoelectric effect exhibited by thin films of alkali metals on specular platinum surfaces is proportional at any wavelength to the electric intensity just above the platinum. This electric intensity is found, using the optical constants of platinum, by computing the intensities of the wave patterns formed by the interference of the reflected and incident beams. These computations are made for various angles of incidence and for light polarized in and at right angles to the plane of incidence. The intensities thus found exhibit very large ratios of value for the two planes of polarization, in striking agreement with the characteristics of the vectorial photoelectric effect. The changes of amplitude of the perpendicular electric vector on entering the alkali metal film, as computed from the optical constants of the alkali metal, account for the experimentally found low values of the emission ratios at long, and their high values, at short wavelengths.

2. The photoelectric effect from thin films of alkali metal on silver. HERBERT E. IVES, AND H. B. BRIGGS, *Bell Telephone Laboratories.*—The thin films of alkali metals which spontaneously deposit in vacuo on other metals have long been known to exhibit photoelectric effects which vary in amount and character, depending on the underlying material, but the exact nature of this dependence has been obscure. Silver, because of its region of exceedingly low reflecting power in the ultraviolet and the accompanying variation of optical constants is exceptionally well suited for studying the influence of the underlying metal. It is found that the region of low reflecting power profoundly affects the photoemission, but in a manner not to be explained simply by reduction of light reflected back through the alkali metal film. The results obtained are very satisfactorily explained upon computing, from the optical constants, the intensity of the standing waves formed by reflection just above the silver surface. The positions of the maxima and minima of photoemission, and their variations with angle of illumination and plane of polarization are accurately indicated.

3. Correlating the selective photoelectric effect with the selective transmission of electrons through crystalline surface structures. A. R. OLPIN, *Bell Telephone Laboratories.*—Evidence is produced to support the view that photoelectrically selective, two-component cathodic surfaces are crystalline in nature. Then, assuming that Fowler's equation for the energy of electrons selectively transmitted through a single potential valley, $W=(n^2h^2)/(8md^2)$, is equally valid for the energy of electrons selectively transmitted through the periodic sequence of valleys characteristic of the potential field within a crystal, and that all of the energy of photoelectrons is acquired from the incident light quanta, the wave-lengths of light to which such a surface should respond selectively can be computed. Such computations have been made with d equal to the internuclear distance between electropositive ions in the lattice structure of alkali metal hydride, oxide and sulphide crystals. The hydride crystals belong to the sodium chloride type and the oxide and sulphide crystals are supposedly of the calcium-fluoride type. The correlation between these computed values and the positions of the observed selective maxima is exceptionally good. Moreover, the fact that the alkali metal hydrides exhibit but one selective maximum and the oxides two or three maxima is in keeping with the geometry of their respective crystalline types.

4. Thermionic emission in caesium-oxide photo-cells at room temperatures. E. F. KINGSBURY, *Bell Telephone Laboratories.*—The measurements on these cells recently reported (Kingsbury and Stilwell, Physical Review **37,** 1549, June 1, 1931) have been extended to a number of cells of a wide variety of treatment during construction. A relation between the thermionic constants, log A and b_0, has been obtained which approximates in slope the relation obtained by Richardson and Young (Proc. of Royal Society **A107,** 377, 1925) for potassium cells sensitized with oxygen. The caesium cells, however, give from 100 to 1000 more emission at corre-

sponding temperatures. The variation in overall photo sensitivity to tungsten light seems to be independent of the thermionic constants. In general the photoresponse decreases with increasing temperature but the behavior is complex, some cells increasing with rise of temperature and some showing an erratic superposition of the two effects.

5. The emission of secondary electrons from tungsten. A. J. AHEARN, *Bell Telephone Laboratories.*—An apparatus is described for investigating critical potentials in the emission of secondary electrons from tungsten. Measurements on the velocity distribution in the primary beam show that secondary electrons from the electron gun are absent. Tube characteristics which might introduce spurious critical potentials in the secondary emission from tungsten appear to be absent. By heat treating the tungsten and cleaning up residual gases, maxima and critical slope changes were developed below 40 volts. From 40 to 500 volts, only 4 critical potentials were observed even with the sensitive methods of measuring and plotting the data, and all but one of these disappeared eventually after heat treatments of the tungsten target. The phenomena may be associated with the diffraction of electrons or the production and absorption of characteristic soft x-rays. Regardless of the mechanism operating at the critical potentials, their decrease or elimination beyond 40 volts points strongly to effects of surface contamination rather than to characteristics of tungsten.

6. Transmission of electrons through potential barrier of thoriated filament. W. B. NOTTINGHAM, *Bartol Research Foundation.*—Thermionic measurements on a thoriated filament showed the electron velocity distribution to be accurately Maxwellian at the temperature of the filament for values of applied potential negative of V_0. At V_0 thus determined, the work function was 3.2 to 3.5 volts. With small accelerating potentials, referred to V_0, the current increased rapidly and reached a fair saturation value at 1.5 to 2.0 volts. Electron velocity distributions from a *deactivated* or pure tungsten filament were Maxwellian at the temperature of the filament. Comparing curves for activated and deactivated filaments heated to give the same "saturation" emission, showed that the velocity distribution from the pure tungsten was accurately reproduced with the activated filament over the range of accelerating potential mentioned above. This result can be ascribed to the transmission of electrons *through* a potential barrier ($B-C=1.4$ volts), 4.5×10^{-8} cm wide at one volt under the top. The transmission coefficient $D(W)$ of the Nordheim-Fowler theory must be a function of the energy of the impinging electrons. Therefore the emerging electrons will certainly not have a Maxwellian distribution at the temperature of the filament. Experimentally the barrier transmits the faster electrons easily, as would be expected, with the result that those transmitted happen to have practically a Maxwellian distribution with a temperature $48\% \pm 3$ higher than the filament.

7. On the theory of thermionic emission. N. H. FRANK, *Massachusetts Institute of Technology.*—A theory of thermionic emission between plane parallel electrodes including space charge effects is developed to include the modifications introduced by quantum mechanics. Two modifications appear; (a) the use of the Fermi-Dirac statistics instead of the classical statistics, and (b) the introduction of a probability of emergence of electrons within the metal which is a continuous function of the electron energies. The effect of (a) alone is to change the expression for saturation current. Expressed in terms of saturation current, all results of classical theory remain unchanged. The introduction of (b) modifies all these results. For the case of accelerating anode potentials high enough to prevent the formation of a potential minimum, the charge density and potential distributions are but slightly altered. For high retarding anode potentials (no potential minimum), the current voltage characteristic is

$$i=i_s\,\epsilon^{-e\phi/kT}\cdot f$$

ϕ is anode potential, i_s saturation current. Classically $f=1$ quantum-mechanically, it is a slowly varying function of ϕ. The charge density and potential distributions for this case are essentially different than the classical expressions. The case of a potential minimum is handled as a combination of the above two cases. Just as in the classical case numerical or graphical integrations are necessary before numerical results can be obtained.

8. Determination of e/m by the refraction of x-rays. J. A. BEARDEN, *Johns Hopkins University.*—Since the usual dispersion theory has been so thoroughly established we may, by measuring the index of refraction of x-rays, use the theory as a means of determining e/m. Measurements of the index of refraction of the Copper K series in a 90° quartz prism have been made by two methods. In the first method the incident beam struck the first face of the prism at a glancing angle larger than the critical angle of total reflection. In the second method the incident beam struck the second face at a very small angle. The alignment of the prism, slits, and plateholder was made as described by the writer in a previous paper (Phys. Rev. **37,** 1210 (1931)). Twenty-nine measurable exposures have been obtained under various conditions. The dispersion formula

$$\delta = 1 - \mu = \frac{e^2}{2\pi m} \sum_i \frac{N_i}{\nu^2 - \nu_i^2}$$

was used for determining e/m. The value of ν was obtained from the writer's grating wave-length measurements. e/m was thus found to be

$$e/m = 1.764 \times 10^7 \text{ e.m.u./g.}$$

This is in good agreement with the results obtained by Stauss (Phys. Rev. **36,** 1101 (1930)) but differs from either of the accepted values of e/m. Calculations of e/m have also been made using the complete dispersion formula which includes the absorption in the prism.

9. An x-ray study of the nature of solid solutions. ROBERT T. PHELPS AND WHEELER P. DAVEY, *Pennsylvania State College.*—(1). The solid solution of pure Al in pure Ag lowers the lattice parameter of the Ag by an amount which is proportional to the Al content of the solution. Saturation of Al in Ag is reached at 5.4 percent Al by weight. Further addition of Al gives aggregates of Ag_3Al of sufficient size to give x-ray diffraction patterns. (2). The experimental values for the densities of the solid solutions of Al in Ag are somewhat lower than those calculated on the basis of a direct substitution of Al atoms for Ag in the Ag lattice. This discrepancy is greater than the combined error in the two values. (3). Systematic examination of the various possible types of explanation for this discrepancy leaves us with only one tenable theory, namely that the Al in the solid solution is chemically combined with the adjacent Ag. If this explanation is used as a basis for a general theory of the nature of solid solutions, the picture is found to be consistent with the known facts for both solid solutions and liquid solutions. So far, it has not been found inconsistent with any known fact.

10. A 1,500,000 volt electrostatic generator. ROBERT J. VAN DE GRAAFF, *National Research Fellow, Princeton University.*—The application of extremely high potentials to discharge tubes affords a powerful means for the investigation of the atomic nucleus and other fundamental problems. The electrostatic generator here described was developed to supply suitable potentials for such investigations. In recent preliminary trials, spark-gap measurements showed a potential of approximately 1,500,000 volts, the only apparent limit being brush discharge from the whole surface of the 24-inch spherical electrodes. The generator has the basic advantage of supplying a direct steady potential, thus eliminating certain difficulties inherent in the application of non-steady high potentials. The machine is simple, inexpensive, and portable. An ordinary lamp socket furnishes the only power needed. The apparatus is composed of two identical units, generating opposite potentials. The high potential electrode of each unit consists of a 24-inch hollow copper sphere mounted upon a 7 foot upright Pyrex rod. Each sphere is charged by a silk belt running between a pulley in its interior and a grounded motor driven pulley at the base of the rod. The ascending surface of the belt is charged near the lower pulley by a brush discharge, maintained by a 10,000 volt transformer kenotron set, and is subsequently discharged by points inside the sphere.

11. Negative hydrogen ions from H_2O by electrons of a critical velocity. DONALD W. MUELLER AND H. D. SMYTH, *Princeton University.*—Lozier and Bleakney have observed negative hydrogen ions appearing over a small range of electron velocities in apparatus containing water vapor. Their result has been qualitatively confirmed using a mass spectrograph. Hydrogen negative ion intensity falls off above and below 8 volts incident electron velocity. Oxygen and hydroxyl negative ions were also observed but increasing in amount above about twenty volts incident electron velocity.

FRIDAY MORNING AT 9 O'CLOCK

Union College—Physics Building

Lecture Room B

12. On the absolute determination of gravity. A. C. LONGDEN, *Knox College, Galesburg, Ill.*—The importance of a new determination is discussed. In the work here described, a reversible pendulum is used in which roller bearings are substituted for knife-edges and quartz suspension rods or tubes are used instead of metal. Invar is disqualified on account of its magnetic qualities. The period of the pendulum is determined to within 1 or 2 parts in a million by a very direct method which involves no corrections and which can be performed in a few minutes, while the pendulum is swinging through a very small amplitude and while the *change* of amplitude is quite negligible. The author points out the errors of the "Coincidence Method" as it is generally used, and shows that it may either be improved, or abandoned as unnecessary. He also cites some of the results on record, which are accepted as highly exact, but which in reality include rather large errors. The method includes a number of refinements in comparing the length of the pendulum with that of a standardized invar rod.

13. Entropy of polyatomic molecules. D. S. VILLARS, *Research Laboratory, Standard Oil Co. (Ind.)*—By applying the data of Hund on ammonia and of Elert on methane to obtain the total number of completely anti-symmetric eigenfunctions which can be formed from the different rotational states, one can get the *a priori* probabilities of the different non-combining symmetry varieties (nuclear doublet and quadruplet for ammonia and nuclear singlet, triplet and quintet for methane) and from them the entropies. The relative proportions at high temperature of the different varieties are one to one for ammonia and 2:9:5 for methane (resp). The absolute entropy of the ammonia mixture is 51.5 cal. degree^{-1} at 298.1°K and of the methane mixture, 50.1 at the same temperature.

14. Some physical properties of compressed carbon monoxide. W. EDWARDS DEMING AND LOLA E. SHUPE, *Bureau of Chemistry and Soils, U. S. Department of Agriculture, Washington, D. C.*—Compressibility data obtained by Bartlett on carbon monoxide have been adjusted and extrapolated so that p, v, T data from −70°C to 400°C and from 25 to 1200 atm. is available. Using the graphical scheme for obtaining derivatives, previously described in similar calculations for nitrogen, the following physical properties have been computed, and are available in tables and curves at eleven temperatures and fourteen pressures, over the range noted above: specific volume, density, expansion coefficients, fugacity, C_p, $C_p - C_v$, C_v, μ. The C_v vs. t isobars for 300 to 1200 atm. show a minimum at about 100°. On the low temperature side of this minimum the curves are very steep; for 1200 atm. C_v drops from 4.4 R at −70° to 2.57 R at 100°. Above 100°, C_v is only a few hundredths cal/mole deg higher than C_v^* (zero pressure) for pressures to 400 atm.; further increase in pressure raises C_v only a few tenths. Below 25°, C_v for $p = 25$ is slightly less than C_v^*; for $p = 100$, 150, 200, C_v falls considerably below C_v^* as t falls to −70°. The C_p vs. p isotherms show that above 500 atm. C_p does not change much with further increase in pressure. Below 0°, decrease in temperature is accompanied by considerable increase in C_p, when $p > 200$.

15. An optical study of heat transfer by convection from solid surfaces to air. R. B. KENNARD, *Bureau of Standards.*—A hot body is placed in one arm of a Jamin interferometer which is built about an open well so as to permit the free circulation of air about the body. The temperature distribution in the air is obtained without the introduction of any thermometric apparatus. The equation relating the fringe shift to the air temperature is developed. Photographs are shown of the fringes near horizontal and vertical plane surfaces. The transition between laminar flow and turbulent flow is shown by the change in the direction of the fringes. The temperature gradient for laminar flow is constant for the temperature range used. If the temperature gradient were constant throughout and the same as for laminar flow, the "equivalent" film would be 5.5 mm thick and independent of the temperature of the hot plate. The interference fringes were photographed about a wire of 3/10 mm diameter, and about cylinders of 5 mm, 12.7 mm and 30 mm diameter. From these photographs the isothermals about these cylinders were plotted, and the relative heat emission along different radii estimated. The relation between the thickness of the layer of heated air and the diameter of the cylinder is noted.

16. Some evidence indicating the existence of Ba isotopes 136 and 137. R. C. GIBBS, AND P. G. KRUGER, *Cornell University.*—In 1925 Aston reported the chief isotope of Ba to be 138, with the possibility that isotopes 136 and 137 might exist in extremely small quantities. From such data one would expect the Ba lines to show no hyperfine structure, since elements with an even atomic weight in general have a nuclear spin of zero. The Ba II lines λ's 4554A and 4934A ($6s^2S_{1/2}-6p^2P_{3/2,\ 1/2}$) show structure when photographed with a Fabry-Perot interferometer, the satellites combined having roughly one tenth the intensity of the parent line. This leads one to think that the satellites are probably due to an odd isotope (137) and that the parent line is due to the even isotopes (136 and 138). A mixture of 27 percent of isotope 136, 9 percent of isotope 137 and 64 percent of isotope 138 gives 137.37 for the average atomic weight, which agrees with the chemical atomic weight of Ba. This gives an even to odd ratio of isotopes of about 10:1, and so roughly checks with the intensity relation in the structure of the lines.

17. Quantitative intensity determinations in the spectra of normal and of singly ionized Vanadium, VI and VII. GEORGE R. HARRISON, *Massachusetts Institute of Technology.*—The relative intensities of all lines of VI and VII stronger than 1/2 of 1 per cent of the intensity of the principal lines and lying between λλ5200 and 2500A. have been determined under various conditions of excitation in the vacuum arc, using the first and second orders of a 35 ft. concave grating and standard methods of photographic photometry. The proportionate number of anomalous lines found is somewhat greater than in Ti I and II, and less than in Cr I and II, as is to be expected from the multiplet separations and the number of terms of similar J value which can perturb one another. The spectral analysis used is a fairly complete one kindly furnished in advance of publication by Dr. W. F. Meggers. The data obtained are being used to test the excitation conditions in the vacuum arc, the J-group sum rule of Johnson and the writer (Phys. Rev. **37,** 1702, 1931 and issue for Aug. 15, 1931), and the role played by quantum numbers and the magnetic and electrostatic term separations in determining the intensity perturbations produced in a given line. Attempts are now being made to extend these data to both longer and shorter wave-lengths.

18. Band spectrum intensities by graphical methods. ELMER HUTCHISSON, *University of Pittsburgh.*—In order to facilitate the comparison of experimentally determined band intensities with those predicted by theory, an easy and rapid method of determining the theoretical results is desirable. Making use of the author's previous calculations (Phys. Rev. **36,** 410 (1930); **37,** 45 (1931)), based upon the Franck-Condon principle, charts have been prepared which permit a graphical determination of the intensities of vibrational bands in electronic transitions. Transition probabilities associated with the lowest energy levels are given by means of contour lines on a chart in which the changes in the equilibrium distances between the atoms during the transitions are plotted as ordinates and the square roots of the ratios of the vibrational frequencies in the lower and upper states are plotted as abscissas. Besides the squares of the transition probabilities, the complete expression for the intensities in absorption involves the fourth powers of the frequencies of the bands and the populations of the initial states which are also obtained graphically as a function of the temperature of the absorbing gas. The use of these charts allows a rapid estimation of the band intensities in any particular electronic transition. As an example of the use of these charts, the band intensities of the $^1\Sigma-{}^1\Sigma$ transition of AgH are calculated. The computed values are found to be in fairly good agreement with the experimental results of Hulthèn and Zumstein (Phys. Rev. **28,** 13 (1928)).

19. The Kerr-effect in Rochelle salt. HANS MÜLLER, *Massachusetts Institute of Technology.*—An electric field parallel to the a-axes of Rochelle salt produces a large electro-optical effect which does not reverse with the direction of the field. This effect has been measured for temperatures between 0 and 35°C and fields up to 30 kv/cm. The effect exists in the entire temperature region but has a sharp maximum at about 23°C. The change of the difference between the indices of refraction n_a-n_b resp. n_a-n_c is not proportional to the square of the field strength but increases almost linearly up to 15 kv/cm. At higher fields the effect tends towards saturation. The effect is not due to temperature change due to conduction. It is much too large to be accounted for by electrostriction. The observations support the hypothesis that the anomalous dielectric and piezoelectric properties of Rochelle salt are due to the fact that the electric dipoles of the H_2O molecules of the water of crystalization behave similarly to the magnetic dipoles in the case of ferromagnetism.

20. The hall effect in solid mercury. JAMES T. SERDUKE AND THOMAS F. FISHER, *Union College.* (*Introduced by P. I. Wold.*)—Various investigators have studied the Hall effect in Hg, especially in the liquid form. In the liquid form the results are uncertain and subject to doubt. In the solid form Fenninger in 1914 found the Hall constant to be not larger than 0.000011. The present investigators developed a method of obtaining a Hg strip 14 cm long, 2 cm wide and of various thickness down to 0.006 cm and have measured the Hall effect and resistivity in solid mercury at a temperature of about $-60°$C. The conclusions are that in this case the Hall effect is negative and the constant has a value of -0.00078 ± 10 percent. The Hall constant is independent of field strength, current density and thickness of specimen. No definitely measurable longitudinal effect, i.e. change in resistivity with magnetic field was found.

21. Exhibition of parallax panoramagrams made with a large diameter concave mirror. HERBERT E. IVES, *New York City.*—The general methods by which relief pictures may be made by a single exposure, using a large lens or mirror, have been described previously (J.O.S. A. **20,** 597(1930)). The pictures exhibited were made by means of a strip of spherical concave mirror of 48 inch diameter and 48 inch radius, built up out of three 16 inch sections. The light from the object after leaving the concave mirror is reflected to one side by means of a 45° half silvered mirror. An opaque line grating of 20 lines to the inch, with clear spaces 1/50 the width of the opaque is placed slightly in front of the sensitive plate, and a similar grating, slightly behind a positive print on glass converts this into a relief picture. Details of the "camera," which consists of a dark room with a large window, are given. The pictures are notable, as compared with pictures previously exhibited, made with a large lens, for the larger angle (60°) through which relief is observed.

SUPPLEMENTARY PROGRAM

When two or more papers are offered by the same member, one only of these will be assigned a place on the regular program, while the others will be placed in a supplementary program, to be called for if time permits.

Papers received after the program has been printed will be placed in the supplementary program.

The papers in the supplementary program may be called for at any session in Room A after the completion of the regular program for the session.

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